



Status October 2004:

- 1) Introduction
- 2) Source principle
- 3) Proton beam
- 4) UCN source
- 5) Some impressions



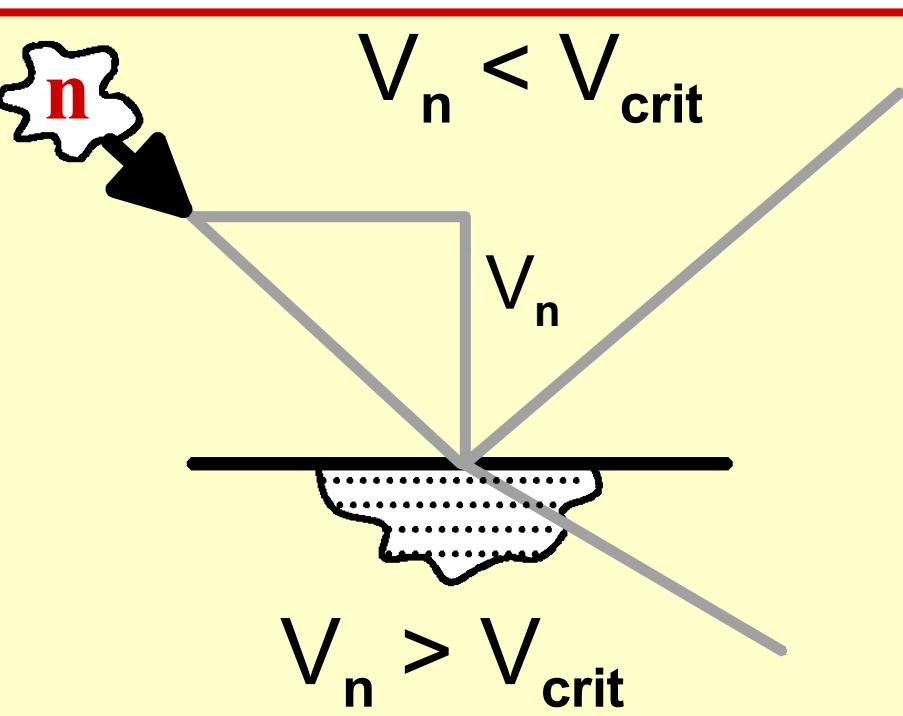
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PNPI contributions (1998 – 2004)
are gratefully acknowledged

kinetic energy
velocity
wave length
Temperature

$E(\text{UCN}) \leq 250 \text{ neV}$
 $v(\text{UCN}) \approx 0 - 7 \text{ m/s}$
 $\lambda(\text{UCN}) \geq 50 \text{ nm}$
 $T(\text{UCN}) \leq 3 \text{ mK}$



Potentials:

^{58}Ni	$+335 \text{ neV}$
Be, BeO	$+260 \text{ neV}$

$+ \rightarrow$ repulsive

total reflection:

**Storage in vessels,
Long observation times!**

BAU, Baryon asymmetry in the universe:

Naive expectation from Big Bang: BAU $\approx 0 = 10^{-\infty}$

CP violation in K and B mesons: BAU $\approx 10^{-20}$

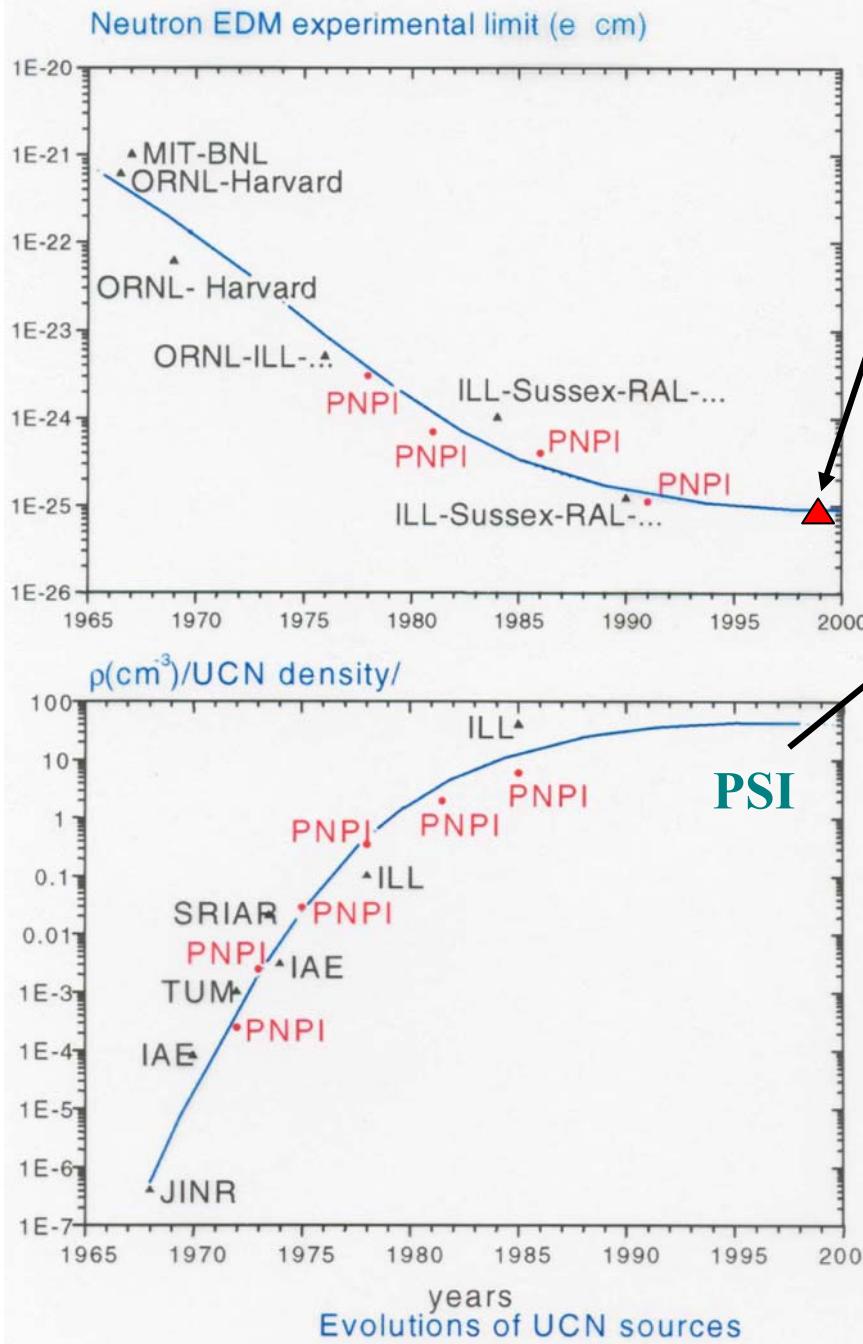
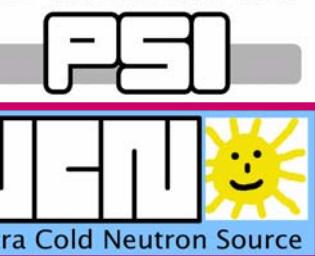
$$\text{BAU} = (n_{\bar{b}} - n_b) : (n_{\bar{b}} + n_b) \sim 10^{-10}$$

MSSM, Minimal Super Symetric Model:

- 1) Can explain baryon asymmetry $\sim 10^{-10}$
- 2) nEDM $\sim 10^{-25}$ to 10^{-27} e•cm
- 3) Standard model: $\sim 10^{-31}$ e•cm

Today: nEDM $\leq 6.3 \cdot 10^{-26}$ e•cm

$\tau = (885 \pm 1)\text{s}$ or $(878 \pm 1)\text{s}$ or ???

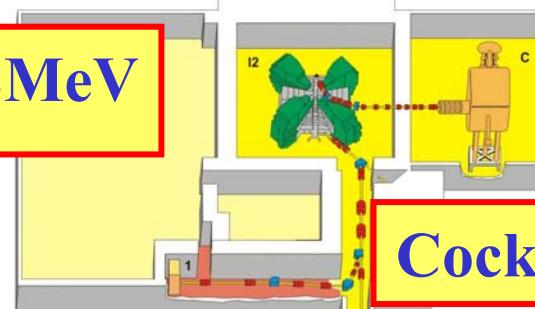


$\leq 6.3 \cdot 10^{-26} \text{ e} \cdot \text{cm}$
Sussex-ILL

2008

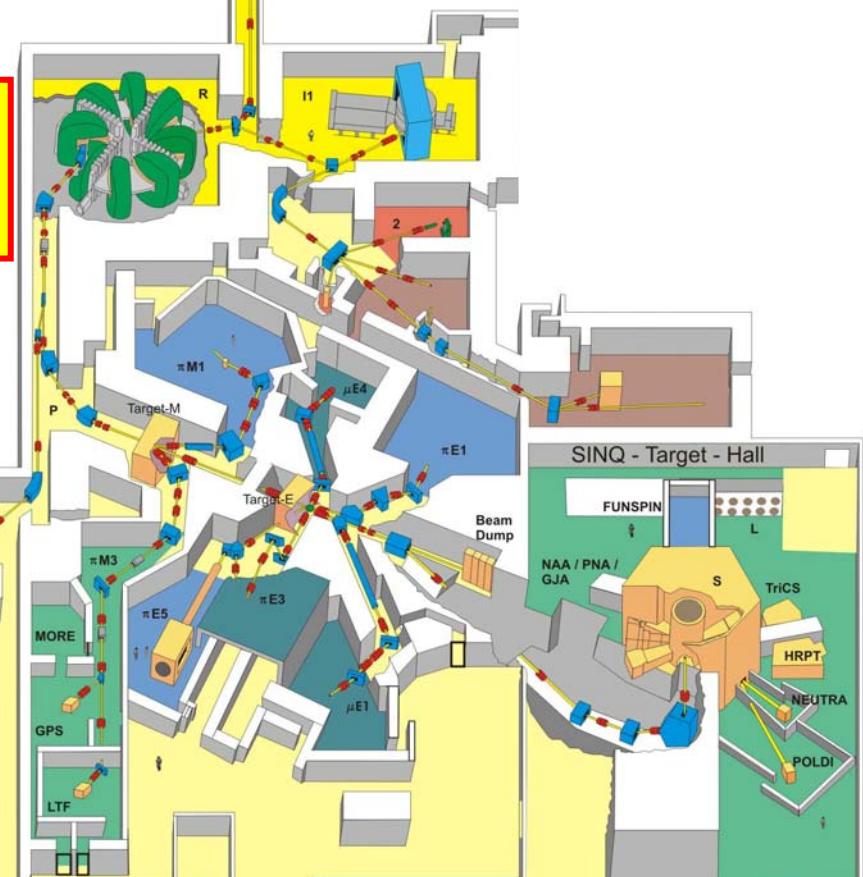
PSI et al.
>2008

Injector II: 72MeV



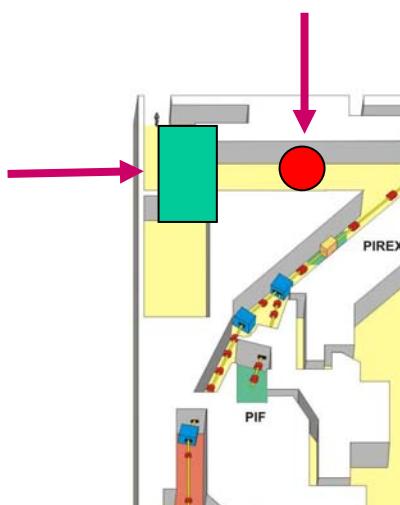
Cockcroft-Walton: 872 keV

Ring cyclotron: 600MeV, 2mA
→1.2MW (unique!)

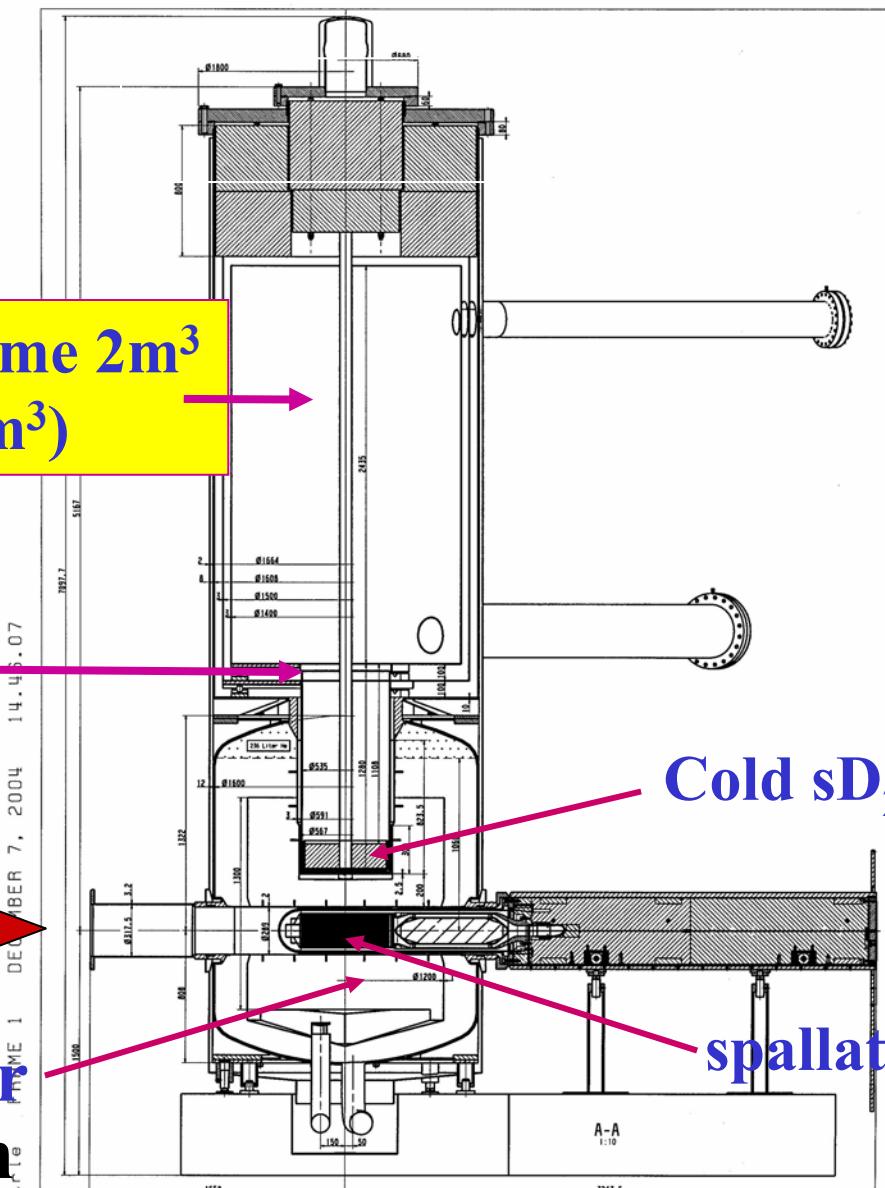


UCN Source

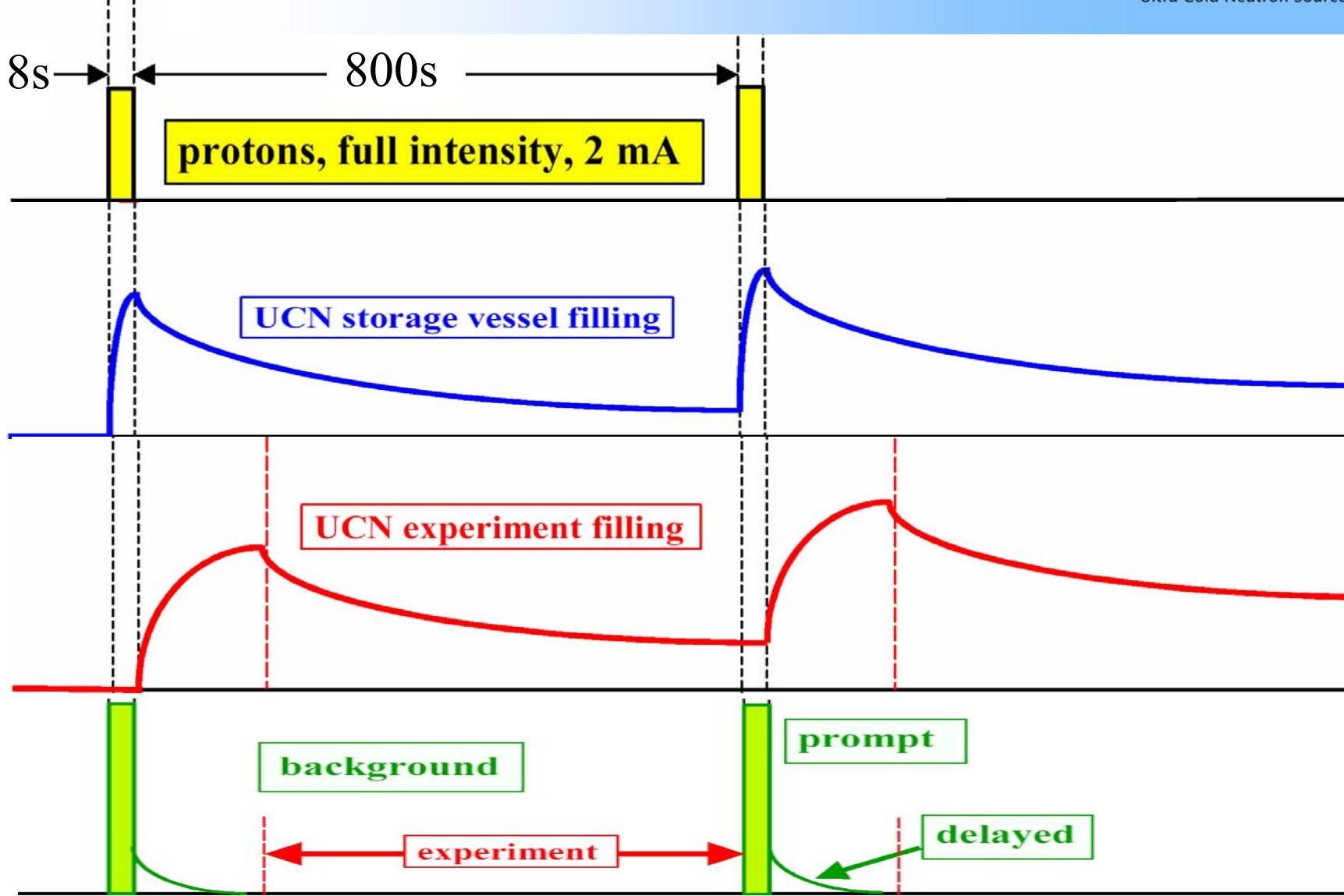
nEDM
experiment



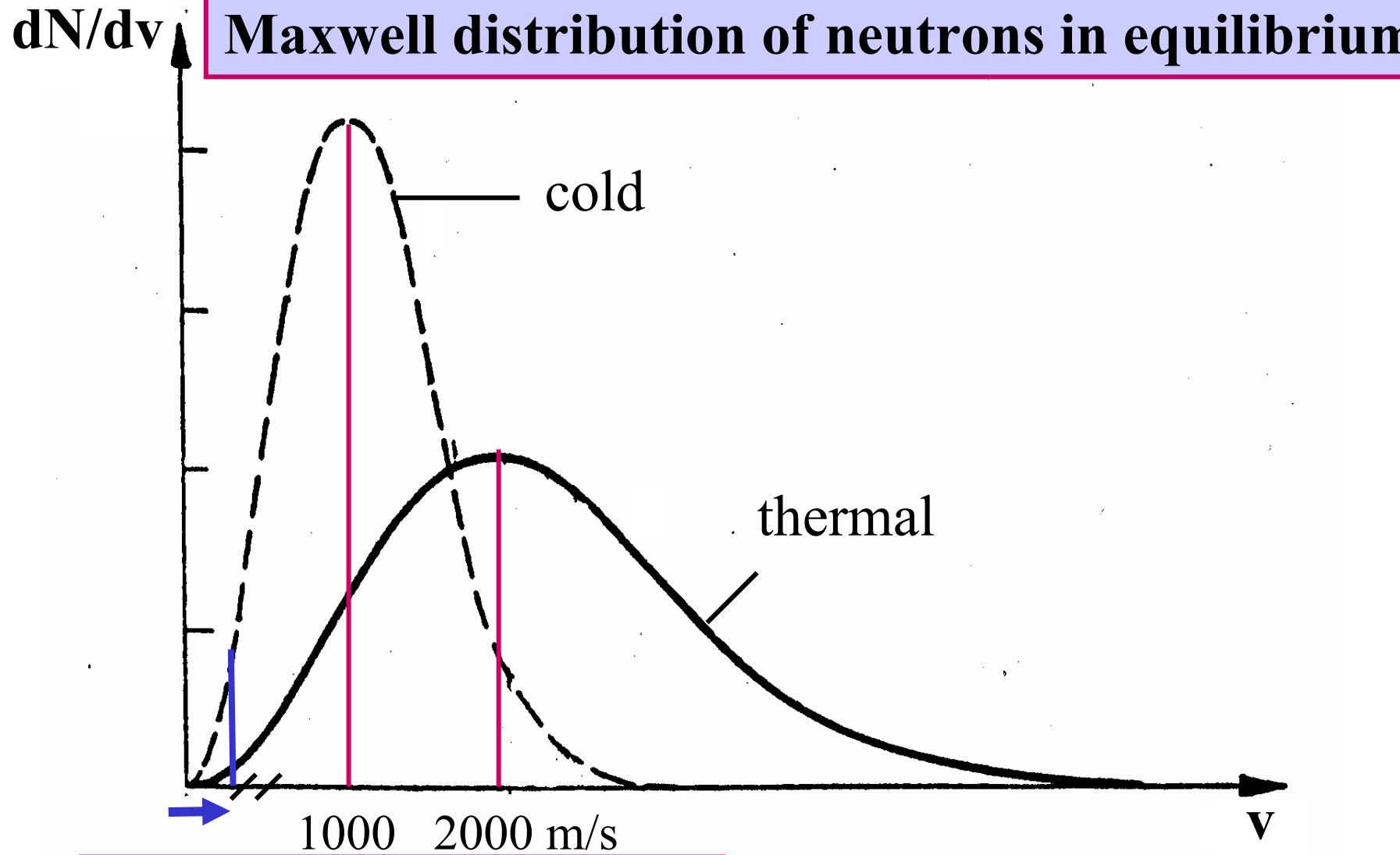
UCN tank system (5 m high)



Pulsed UCN source



How are UCN produced?

UCN, $v \leq 7$ m/s (not to scale)

At PSI UCN source in D₂O:

$$\rightarrow \rho(UCN) = 8 \text{ UCN cm}^{-3} \text{ at T} = 300\text{K}$$

Measured gain factor at T = 5 K: 1200

$$\rightarrow \rho(UCN) = 9'600 \text{ UCN cm}^{-3} \text{ at T} = 5\text{K}$$

After extraction losses: $\rho(UCN) \approx 3'000 \text{ UCN cm}^{-3}$

confirmed by own experiments at PSI SINQ:

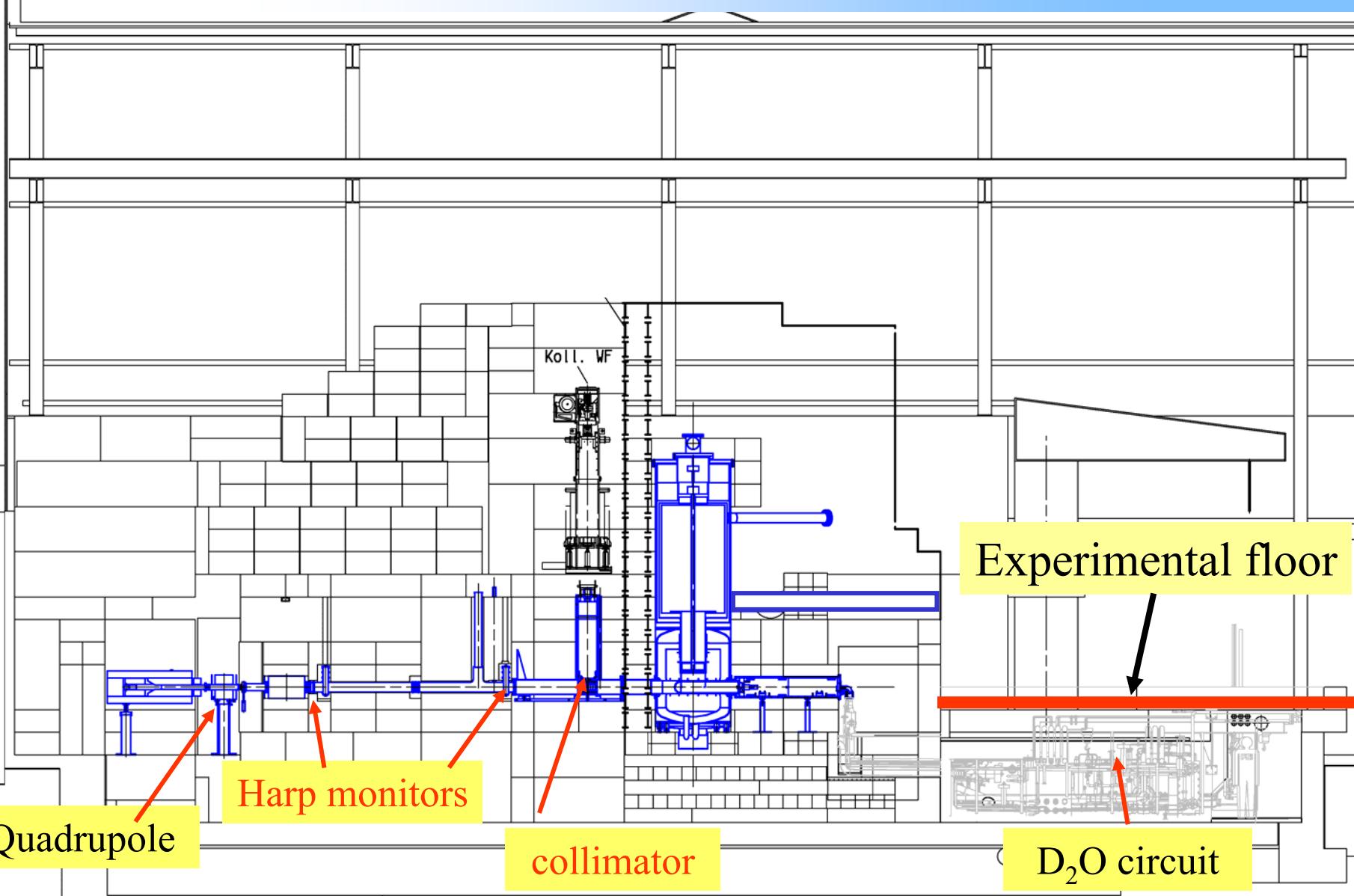
F. Atchison et al.,

Production of ultra-cold neutrons from a cold neutron beam on a ²H₂ target,

Phys. Rev. C 71, 054601 (2005).

Remember: at ILL $\rho(UCN) \approx 40 \text{ UCN cm}^{-3}$

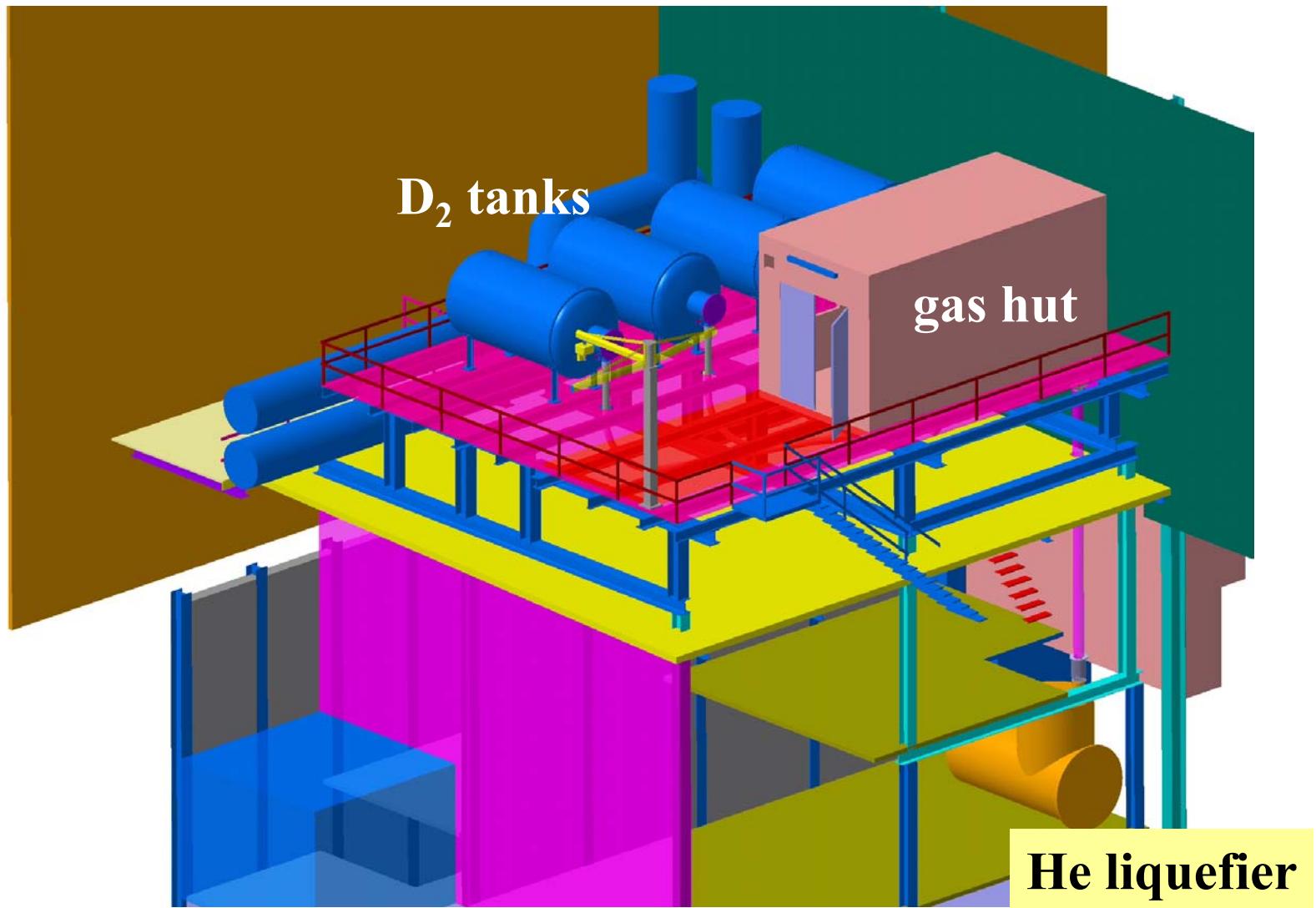
Proton beam



Collimator vacuum chamber



D₂ Gas System

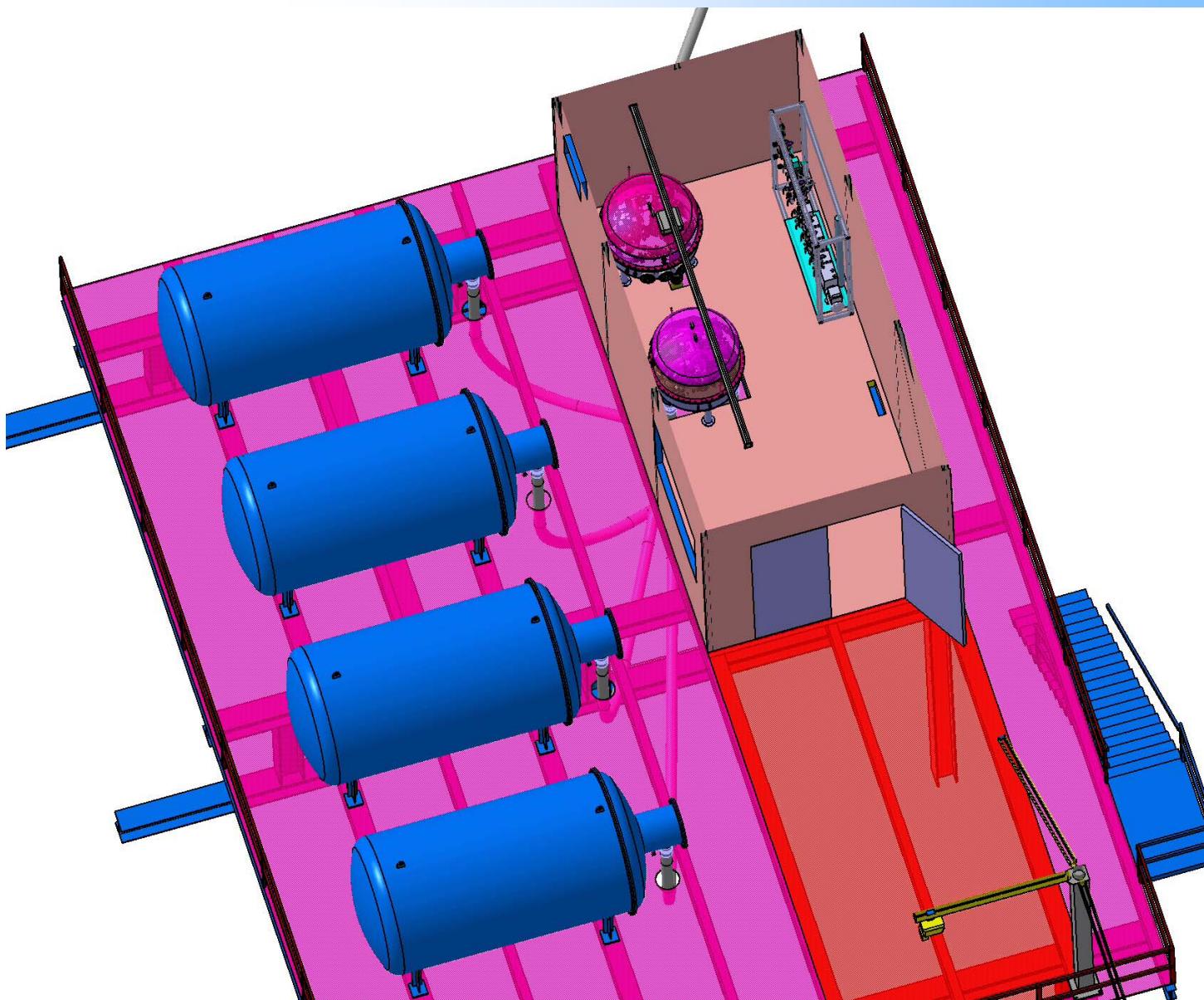


Helium liquefier (supercritical He)



500 W @ 4.7K
3000W @ 70K

Deuterium system



D₂ Gas Hut

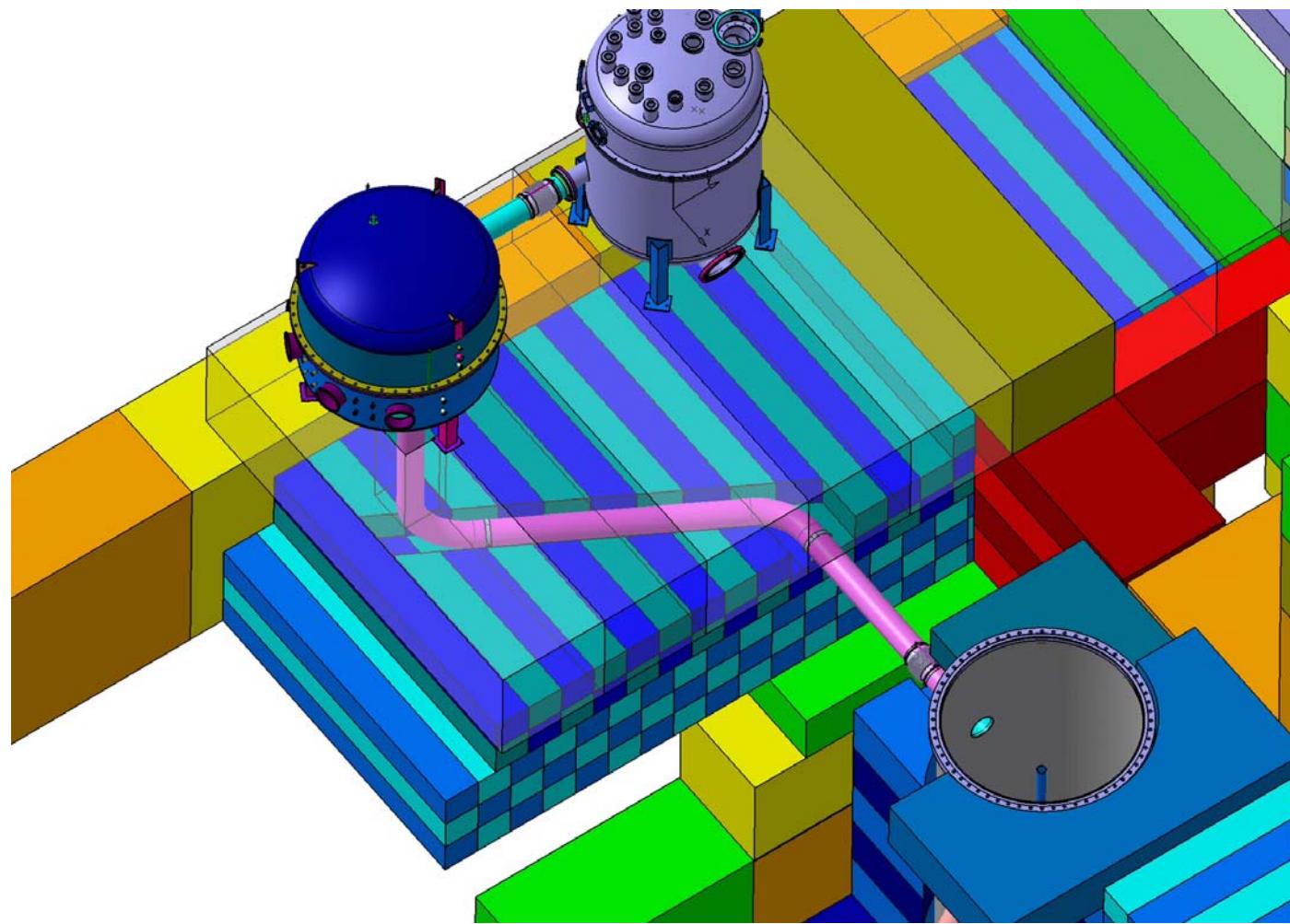




UCN gas tanks @ PSI



Vacuum system



Isolation Vacuum System



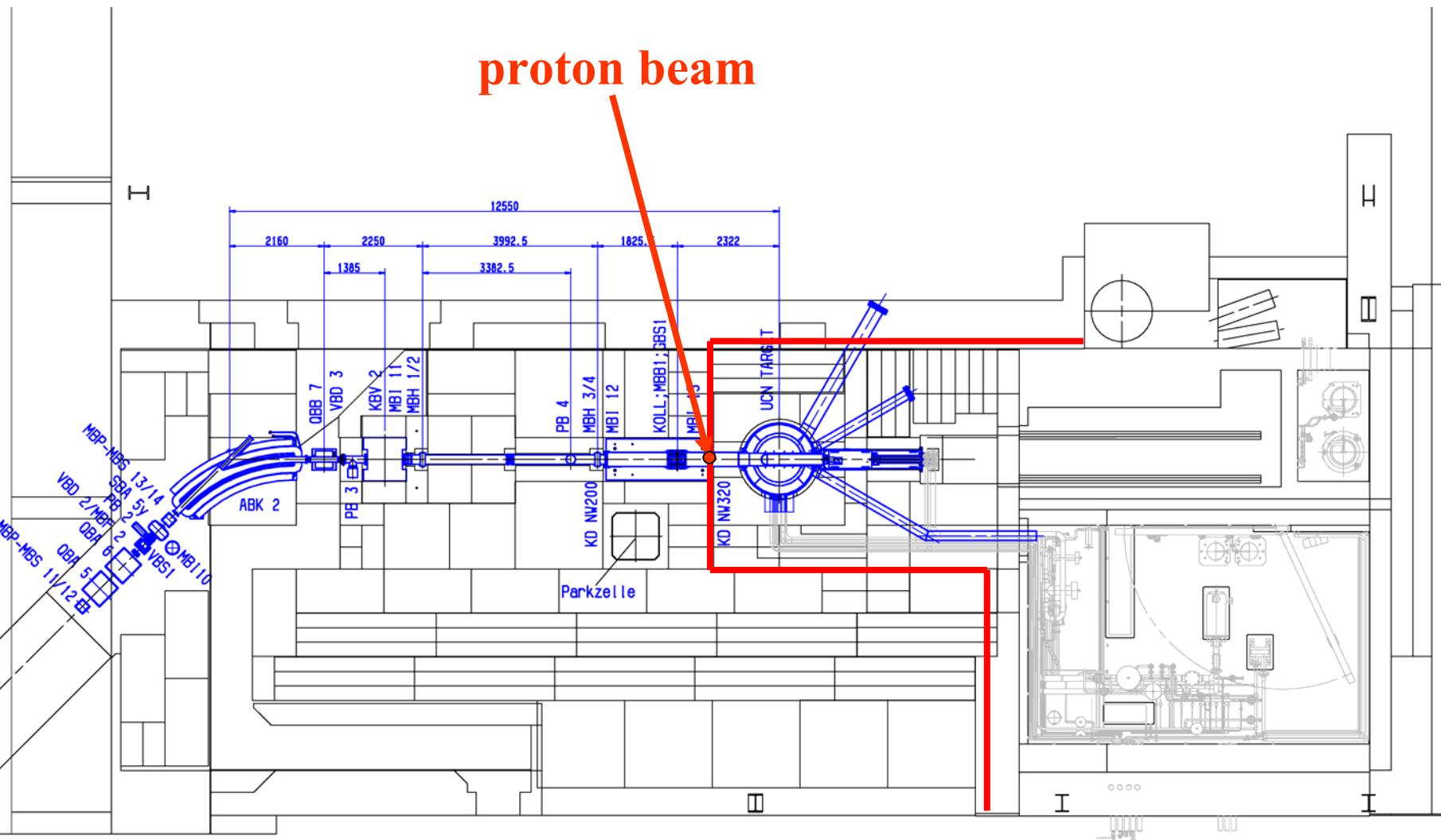
vacuum system
already integrated
in containment

Emergency exit



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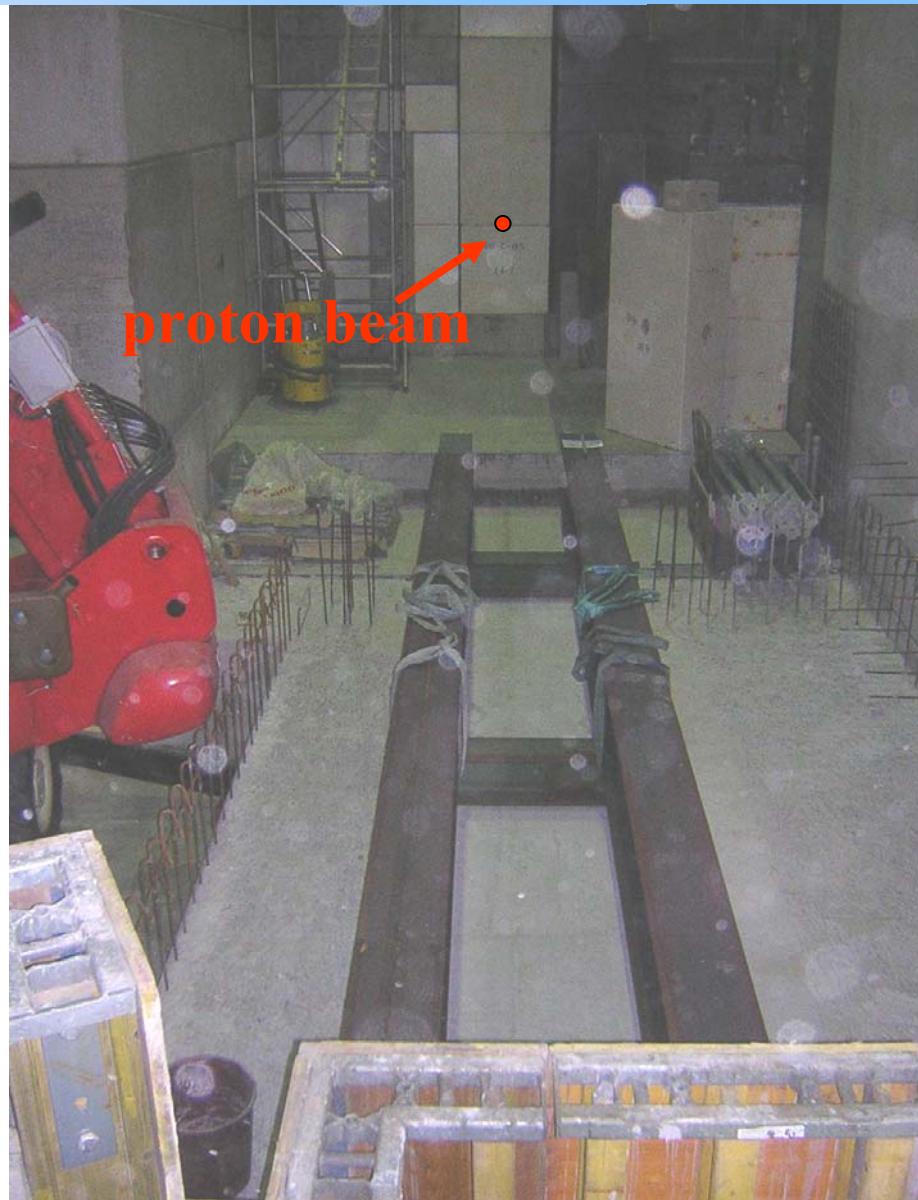
Proton beam to PSI UCN source



Shielding around UCN source



Shielding around UCN source



Shielding wall "West"



Civil engineering



On the way to the top!



1. UCN: spring 2008